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Does every US smoker bear the same cigarette tax?

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Abstract

Aims—To evaluate state cigarette excise tax pass-through rates for selected price-minimizing strategies.

Design—Multivariate regression analysis of current smokers from a stratified, national, dual-frame telephone survey.

Setting—United States.

Participants—A total of 16 542 adult current smokers aged 18 years or older.

Measurements—Cigarette per pack prices paid with and without coupons were obtained for pack versus carton purchase, use of generic brands versus premium brands, and purchase from Indian reservations versus outside Indian reservations.

Findings—The average per pack prices paid differed substantially by price-minimizing strategy. Smokers who used any type of price-minimizing strategies paid substantially less than those who did not use these strategies ($P < 0.05$). Premium brand users who purchased by pack in places outside Indian reservations paid the entire amount of the excise tax, together with an additional premium of 7–10 cents per pack for every $1 increase in excise tax (pass-through rate of 1.07–1.10, $P < 0.05$). In contrast, carton purchasers, generic brand users or those who were likely to make their purchases on Indian reservations paid only 30–83 cents per pack for every $1 tax increase (pass-through rate of 0.30–0.83, $P < 0.05$).

Conclusions—Many smokers in the United States are able to avoid the full impact of state excise tax on cost of smoking by buying cartons, using generic brands and buying from Indian reservations.

Keywords

Behavior; cigarette smoking; pass-through rate; prices; smoking; taxes

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Declaration of interests

None.

INTRODUCTION

Tobacco consumption is a leading cause of preventable death in the world, with 100 million deaths attributed to it during the 20th century and nearly a billion deaths projected for the 21st century [1]. In the United States, despite declines in adult cigarette smoking prevalence during the past 50 years, tobacco use remains the nation's leading preventable cause of death and disease [2].

Increases in unit price of cigarettes are inversely related to smoking [3–5]. Excise tax is one of the primary public health strategies used to increase price [1,6,7]. However, instead of quitting or reducing consumption, smokers may seek lower-priced cigarettes, thereby potentially undermining the public health benefit of tax increases [8–19].

A common misconception is that excise tax is passed homogeneously to smokers at a rate of 1.0, meaning a $1 tax increase is assumed to raise the retail price by $1 across all smokers. This is also known as the 'pass-through rate'. The majority of the existing literature, with the exception of two papers [20,21], suggests that the overall pass-through rate of excise taxes in the United States is greater than or equal to 1.0 (also known as over-shifted) [20–27]. In addition, consistent with economic theory, global evidence has also shown that cigarette or alcohol excise taxes are not passed homogeneously to all users [20–26,28–31]. The pass-through rates may vary widely by brand or type of vendors [25,31], manufacturers' market power [30], the distance to cheaper resources [20,23,24,26] or the type of excise tax [28,29].

By using data from the 2009–10 National Adult Tobacco Survey (NATS), which uniquely collected self-reported cigarette price paid and detailed information on the use of selected price-minimizing strategies, we evaluate average prices paid and pass-through rates of state excise tax by smokers' strategy.

DATA AND METHODS

Data

NATS—The 2009–10 NATS is a stratified, national, dual-frame telephone survey. The NATS questionnaire consisted of 130 questions, including those on cigarette smoking and respondents' demographics. The NATS target population was non-institutionalized adults aged 18 years or older residing in the 50 US states and the District of Columbia (DC). The sample was designed to be representative at both national and state levels. Additional information about the NATS survey is available online [32]. For the purpose of this analysis, the sample was limited to current smokers, who reported smoking at least 100 cigarettes during their life-time and now smoked every day or some days (n = 16 542).

Demographics—Demographic characteristics assessed include, gender, age groups (18–24, 25–34, 35–44, 45–54, 55–64 or 65+ years), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic or non-Hispanic other), household income (<$30 000, $30 000–49 999, $50 000–99 999 or $100 000+), education level (less than high school, high school diploma, some college or college-educated), marital status (married or cohabitating, widowed/ divorced/separated or never married) and unemployed (yes or no).

Brands—Smokers were asked about the brand name of cigarettes they most often purchased during the past 30 days. Seventeen potential choices include: Basic, Camel, Doral, Forsyth, GPC, Kool, Marlboro, Misty, Newport, Pall Mall, Parliament, Salem, Sonoma, USA Gold, Virginia Slims, Winston, and other. Basic, Doral, GPC, Misty, Sonoma and USA Gold are considered generic brands in this analysis.

Price-minimizing strategies—We analysed four questions on self-reported price-minimizing strategies: carton purchase ('the last time you bought cigarettes for yourself, did you buy them by the pack or by the carton?'); coupon use ('the last time you bought cigarettes, did you take advantage of coupons, rebates, buy-1-get-1-free, 2-for-1, or any other special promotions for cigarettes?'); purchase on Indian reservations ('in the past 12 months, that is, since [date], have you bought cigarettes on an Indian reservation?'); and purchase of generic brands during the past 30 days.

Price per pack—Smokers who purchased by pack(s) the last time they bought cigarettes were asked about price in dollars (after discounts and coupons were applied) for the last pack they purchased. Smokers who purchased a carton(s) the last time they bought cigarettes were asked to report price per carton. We converted price per carton data to units of price per pack, by dividing prices per carton by 10.

Season—Using the month of the interview, we created three indicators: October–December, January and March and April–June, to capture potential seasonal variations in cigarette price [33].

State-level tobacco-related variables—Monthly state excise tax data from 2009 to 2010 were obtained from the Tax Burden on Tobacco [34]. To control for state-level unobserved confounding factors that may affect price paid, we used three state measures: strength of smoke-free air laws, tobacco control funding per capita and anti-smoking sentiment. Data on smoke-free air laws and tobacco control funding per capita were obtained from the ImpacTeen project (http://www.impacteen.org). The data on 2009–10 smoke-free air laws included state smoking bans at bars, restaurants and private work-places. We combined the smoking ban information from these three settings (in each setting, the code was 0 for no policy in place, 1 for some restrictions and 2 for complete ban) into one variable representing the strength of smoke-free air laws in each state (on a scale of 0–6, 6 being the complete smoking ban in all three settings). Tobacco control funding was the state appropriation in 2009. State anti-smoking sentiment data were obtained from the NATS question on whether smoking was allowed inside the home (excluding decks, porches or garages). We calculated the prevalence of people who never allow smoking inside their home for each state and used that variable to represent state anti-smoking sentiment [35].

Statistical analysis

Descriptive statistics were estimated for the six subgroups: pack purchase with or without coupon use; carton purchase with or without coupon use; purchase of generic brands during the past 30 days; and purchase on Indian reservations during the previous year. We stratified by demographic variables and adjusted for sample design effects; χ^2 tests were used to test

statistical significance within groups ($P \leq 0.05$). We suppressed estimates with a denominator sample size less than 30, or a relative standard error more than 30% [36].

We compared average per pack prices among pack purchasers, carton purchasers, premium brand purchasers and generic brand purchasers, those who purchased cigarettes on Indian reservations during the past 12 months and those who did not purchase on Indian reservations during the past 12 months. Within each of those groups, we stratified on coupon use, yielding 18 comparison groups. We compared unadjusted averages with averages adjusted for other price-minimizing strategies to account for the use of overlapping strategies, using the regression specification in the following:

$$Per\ pack\ price\ paid = \beta_1 + \beta_2 OtherPMS,$$

where the dependent variable was individual per pack price and coefficients, β_2, reflected price reductions associated with overlapping price-minimizing strategies (*OtherPMS*). Therefore, the constant, β_1, presented the adjusted average per pack price before using any other price-minimizing strategies (e.g. the adjusted average price for carton purchasers was obtained by controlling for coupon use, purchase from Indian reservations and brand choice).

For each of the 18 groups described above, we also used separate multivariate regressions with the following specification to estimate pass-through rates of excise tax:

$$Per\ pack\ price\ paid = \beta_1 + \beta_2 Tax + \beta_3 OtherPMS + \beta_4 Demographics + \beta_5 Season + \beta_6 state.$$

The key variable of interest was state monthly excise tax (*Tax*). The covariates of other price-minimizing strategies were used to control for potential impacts of overlapping strategies on the actual price paid. Therefore, the coefficient, β_2, represents the pass-through rate of excise tax by price-minimizing strategy, independent of use of other strategies.

To illustrate potential impacts of state-level factors on the estimated pass-through rate by price-minimizing strategy, we used two identical regression models to assess the sensitivity of these estimates, except one with additional controls for state covariates (*state*) and one without. We also performed statistical tests to compare the differences in estimated pass-through rates for pack versus carton purchasers, those who purchased cigarettes on Indian reservations during the past 12 months versus those who did not and the users of premium versus generic brands. All analyses were conducted with SAS-callable SUDAAN (version 9.2). Post-stratification sampling weights were incorporated into all analyses to account for the complex survey design of the NATS and non-response.

RESULTS

Table 1 shows demographic and cigarette use characteristics of current smokers by price-minimizing strategy. Among 16 542 smokers, 54.0% (10 393) used one or more strategy. Specifically, 61.3% purchased cigarettes by pack without coupon, 14.9% purchased by pack with coupon, 19.0% purchased by carton without coupon, 4.7% purchased by carton with

coupon, 8.8% purchased cigarettes on Indian reservations and 23.6% purchased generic brands.

Characteristics by price-minimizing strategy

Pack purchase without coupon decreased with increasing age (Table 1). Minority, male and employed smokers were more likely to purchase by pack without a coupon than white, female and unemployed smokers, respectively. Smokers who were not in a relationship at the time of the interview were more likely to purchase by pack without coupon than those who lived with partners or were married. Pack purchase with coupon decreased with increasing household income.

The proportion of smokers who made carton purchase increased with age. Carton purchase without coupon was more common among non-Hispanic white, female, unemployed smokers or those who had a bachelor degree or higher, while it was less common among those who were not in a relationship. Smokers who were not in a relationship were also less likely to purchase cigarettes by carton with coupon, whereas unemployed smokers were more likely to use this strategy.

Cigarette purchase made on Indian reservations was more common among smokers of race/ethnicity other than non-Hispanic white, non-Hispanic black and His-panic and among the employed, although it was less common among those who were not in a relationship. The proportion of smokers who bought generic brands increased with age, but decreased as household income rose. Generic brands were used more commonly by non-Hispanic white, female or unemployed smokers, but were less popular among those who were not in a relationship.

Non-daily smokers, smokers who consumed fewer than 10 cigarettes per smoked day, smokers with quit attempts during the previous year or smokers who consumed after the first hour of their day were more likely to purchase cigarettes by pack.

In contrast, carton purchase was more common among daily smokers, smokers who consumed more than 10 cigarettes per day, smokers without quit attempts or smokers who smoked within the first hour of their day (Table 1). A similar situation also existed among generic brand users. Indian reservation purchase, however, was more common among smokers who consumed more than 20 cigarettes per day.

Average price per pack by price-minimizing strategy

Table 2 presents unadjusted and adjusted average prices per pack by price-minimizing strategy. The unadjusted average per pack price paid by pack purchasers was $5.48, whereas that of carton purchasers was $4.06. After adjusting for brand choice and likelihood of purchasing on Indian reservations, the average per pack price for premium brands was $5.62 for pack purchasers and $4.38 for carton purchasers. Also, coupon use saved another 60 cents per pack for pack purchasers or 2 cents for carton purchasers. Consequently, compared with pack purchasers with no coupon used, carton purchasers would save $1.26 per pack or $12.6 per carton with coupons.

Compared with the unadjusted average per pack price, $5.15, paid outside Indian reservations, those who purchased cigarettes on Indian reservations during the past 12 months paid $4.74. After adjustment of brand choice and quantity purchased, the average price for premium brands was $5.62 for purchases outside Indian reservations. The adjusted average price of Indian reservation purchases was $5.67. Overall, coupon use discounted another 10 cents per pack for smokers who purchased cigarettes on Indian reservations during the past 12 months, or a 57-cent per pack discount for purchases outside Indian reservations.

The unadjusted average price for premium brands was $5.42 per pack, whereas that of generic brands was $4.31. After controlling for quantity purchased and likelihood of purchasing from Indian reservations, the adjusted average price was $5.63 for premium brands which, as expected, is very similar to the average price paid by pack purchasers ($5.62) or paid outside Indian reservations ($5.62) after adjustment. The adjusted per pack price for generic brands was $4.74, representing a saving of 56 cents. Coupon use discounted additional 57 cents for premium brand smokers, although it did not provide significant discount for smokers of generic brands.

Cigarette excise tax pass-through rates by price-minimizing strategy

The estimated pass-through rates of state excise tax are reported in Table 3. Controlling for demographic characteristics, season and price-minimizing strategies the pass-through rate was 1.18 for pack purchasers, meaning that a $1 increase in excise tax was associated with roughly a $1.18 increase in price paid for premium cigarettes outside Indian reservations. After including the state covariates, the pass-through rate was approximately 1.10. With the same controls, the pass-through rate was 0.66 for carton purchasers, indicating that a $1 increase in tax was associated with a 66-cent increase in price paid by carton purchasers for similar cigarettes. The differences in corresponding pass-through rates between pack and carton purchasers (e.g. 1.10 versus 0.66) are statistically significant.

The pass-through rate for smokers who purchased cigarettes from Indian reservations during the past 12 months was 0.50 after controlling for demographic, season, state variables and overlapping price-minimizing strategies. The pass-through rate was reduced further to 0.30 with coupon use, whereas the corresponding estimate for comparable purchases outside Indian reservations was 1.07. The differences in these corresponding pass-through rates (e.g. 1.06 versus 0.50) are also statistically significant.

The pass-through rate was 0.82 for smokers of generic brands when controlling for demographic, season, state variables and overlapping price-minimizing strategies, whereas that for premium brand users was 1.04. Again, statistical tests suggest that the pass-through rates for generic brands were significantly lower than those for premium brands (e.g. 1.04 versus 0.83).

DISCUSSION

This study used data from a national representative survey to evaluate smokers' use of price-minimizing strategies, average price per pack paid and pass-through rates of excise tax. We

found that at least 54.0% of current smokers had used one or more strategies in the previous year, and their demographic and smoking characteristics varied by these strategies. Substantial variations also existed in average prices paid with these strategies. Smokers who purchased by carton, who purchased on Indian reservations or who purchased generic brands paid consistently less than those who did not practice these strategies. Coupon use also rendered additional price reductions.

Our study is unique in that we are able to show how the effect of cigarette tax depends upon smokers' price-minimizing strategies, and to demonstrate that not every smoker bore the same amount of tax. Excise tax was over-shifted to smokers of premium brands who purchased by pack outside Indian reservations: for every $1 tax increase, they paid the entire amount of the tax together with an additional premium of 7–10 cents. The estimated over-shifting is consistent with existing evidence, although our data and methodology differ substantially [22,26,31].

More importantly, carton purchasers (23.7%), generic brand users (23.6%) or those who bought cigarettes on Indian reservations (8.8%) did not realize the same increase in price for the tax increase. These smokers paid only 30–83 cents for the additional tax dollar, representing a saving of 17–70 cents. This might be one of the reasons that some previous studies found that the excise tax was under-shifted to some smokers, while most existing studies found the over-shift of excise taxes [20–27].

Because carton purchasers and generic brand users were more likely to be daily, heavy or more addicted smokers, tax savings rendered among these subpopulations might be subsidized by the premiums paid by pack purchasers, who were more likely to be occasional, light or less addicted smokers. Consequently, price-minimizing strategies may disproportionally mitigate the tax effect among daily, heavy or more addicted smokers.

The federal government recognizes that Native American tribes are sovereign nations. Therefore, tribal members are exempted from state excise tax on cigarettes sold on Indian reservations. However, US Supreme Court decisions have suggested that state taxes can be collected on cigarettes sold to non-members on Indian reservations [37–39]. In practice, however, not all states have established inter-governmental agreements with tribes to collect cigarette tax on sales to non-tribe members on tribal lands, as such agreements can be politically and functionally complicated to negotiate [40]. Therefore, on many reservations, state taxes, which ranged from $0.17 to $4.35 per pack on 1 July 2010 [34], are not applied to these sales. This may partly explain the under-shift of excise tax among those who were likely to purchase cigarettes on Indian reservations.

After adjustment for brands and quantity purchased, the average price paid by smokers who were likely to purchase cigarettes on Indian reservations increased considerably, from $4.74 to 5.67, which is comparable to the price paid for a similar purchase outside Indian reservations. This finding implies that smokers were more likely to buy cigarettes of generic brands, or purchase by carton on Indian reservations. Moreover, considering that the tax pass-through rate was statistically lower for those who were likely to have made their purchases on Indian reservations, and remarkably lower than the rate of carton purchase or

that of generic brands, prices in nearby cigarette retailers outside Indian reservations could be much higher than the nation-wide average price [41]. Consequently, smokers who live in close proximity to Indian reservations were likely to spend their time and other resources to purchase 'state tax-free' cigarettes there. However, more refined analysis is warranted to further explore the determinants of Indian reservation purchase.

Young adults, African Americans and Hispanics were more likely to purchase by pack without coupons, but less likely to purchase generic brands. Therefore, tax increases were probably passed on to them in the form of higher cigarette prices. This is consistent with the evidence that these subpopulations are more responsive to tax increases [3,42].

We also found that the tax was shifted more heavily to carton purchasers who used coupon or other discounts than their counterparts who did not. More research is needed to understand the combination of carton purchase and coupon use.

This analysis has some limitations. First, not all smokers in the NATS were asked about purchases on Indian reservations during the past 12 months. Because of an approval delay during the first 2 months of data collection, the Indian reservation question was not added to the questionnaire until late November 2009. However, among 16 542 current smokers, 13 008 (78%) provided a response for this question, and data on this question were collected in all states and DC. Secondly, survey questions about cigarette purchases had different time-frames (e.g. carton purchase and coupon use were asked for the latest purchase, whereas brand choices were asked for the purchase during the past 30 days, and Indian reservation purchase was asked for the past 12 months). This time-frame issue is likely to have resulted in an underestimate of the proportion of smokers who used price-minimizing strategies during the previous year. However, the issue should not affect our findings on pass-through rates, besides interpretations of these findings, as these estimates do not necessary reflect the reductions during that time-period. In addition, smokers may endogenously use price-minimizing strategies in response to excise tax increases. To assess potential impacts of the endogeneity on our findings, we performed two sensitivity analyses. We replicated the analysis by excluding smokers from two states where taxes were raised during the NATS sampling period (Pennsylvania and Washington), and by stratifying samples with above and below the average state excise tax. These sensitivity results suggest that potential impacts of endogeneity on our findings are very limited, except for carton purchasers. The pass-through rate was statistically lower for carton purchasers living in states with taxes higher than the average compared to those living in states with taxes lower than the average. Tobacco regulation at local jurisdictions that changed during the sampling period are not captured in the analysis, although we include comprehensive controls for evidence-based state tobacco control policies. However, these local policy changes are less likely to affect the tax pass-through rate at the national level. Finally, like other telephone surveys, the response rate of the NATS is low (37.6% of the National Council of American Survey and Research Organizations response rate) [43], and the information collected is subject to recall bias. However, the sample used for the analysis is weighted to account for the complex survey design and non-response.

Findings show that, during 2009–10, a substantial proportion of smokers used price-minimizing strategies. By reducing pass-through rates of state excise taxes, these strategies are likely to lower the benefit that increased taxes would have on reducing the demand for cigarettes. The proportion of smokers who use price-minimizing strategies may be likely to rise because of increasing excise taxes in the future. Policies that can reduce such cost-reduction opportunities, such as setting a high floor price for cigarettes, prohibiting discounts or promotions or expanding state-level negotiations with tribes to collect taxes from non-member purchases, would probably be effective in reducing cigarette use and promoting cessation.

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Table 1

Demographic characteristics of current smokers by price-minimizing strategy.[a]

	Pack[b]		Carton[b]			
	No coupon	**Coupon**	**No coupon**	**Coupon**	**Generic brands[c]**	**Indian reservation[d]**
Age (years)						
18–24	72.9 (68.5, 77.2)	18.7 (14.9, 22.4)	5.4 (3.4, 7.3)	–	8.1 (5.7, 10.5)	7.5 (4.9, 10.1)
25–34	68.8 (65.2, 72.4)	16.8 (13.9, 19.7)	11.2 (8.9, 13.5)	3.2 (2.1, 4.3)	14.8 (12.1, 17.5)	8.3 (6.2, 10.3)
35–44	61.3 (57.5, 65.1)	15.3 (12.5, 18.1)	18.4 (15.5, 21.3)	5.0 (3.5, 6.5)	24.1 (20.7, 27.4)	8.2 (6.3, 10.2)
45–54	54.4 (51.1, 57.7)	16.4 (13.4, 19.3)	23.3 (20.7, 25.8)	6.0 (4.6, 7.4)	29.3 (26.4, 32.2)	9.9 (8.1, 11.7)
55–64	50.9 (47.1, 54.8)	7.8 (5.7, 9.9)	35.2 (31.5, 38.9)	6.0 (4.4, 7.6)	39.6 (35.9, 43.3)	9.6 (7.5, 11.7)
65+	44.9 (39.5, 50.2)	5.2 (3.3, 7.1)	43.4 (38.3, 48.5)	6.5 (4.0, 9.0)	47.5 (42.3, 52.7)	11.1 (8.0, 14.2)
P-value	0.00	0.00	0.00	0.00	0.00	0.36
Race/ethnicity						
White	56.3 (54.4, 58.1)	15.2 (13.8, 16.6)	23.0 (21.5, 24.5)	5.5 (4.7, 6.4)	27.2 (25.6, 28.9)	9.1 (8.2, 10.1)
Black	77.8 (73.3, 82.3)	11.9 (8.0, 15.8)	7.4 (5.1, 9.7)	–	16.0 (12.5, 19.4)	4.5 (2.4, 6.6)
Hispanic	72.5 (66.2, 78.9)	15.8 (10.6, 21.1)	10.0 (6.0, 14.0)	–	10.8 (7.1, 14.5)	9.5 (5.3, 13.8)
Others	62.7 (56.8, 68.5)	16.6 (12.0, 21.2)	16.1 (12.0, 20.2)	4.6 (2.3, 6.9)	22.8 (18.1, 27.6)	12.9 (9.4, 16.3)
P-value	0.00	0.38	0.00	0.00	0.00	0.00
Gender						
Male	64.6 (62.3, 67.0)	14.2 (12.5, 16.0)	16.6 (14.9, 18.2)	4.6 (3.6, 5.6)	20.6 (18.7, 22.5)	8.4 (7.2, 9.7)
Female	57.1 (54.8, 59.4)	15.9 (13.9, 17.8)	22.2 (20.5, 24.0)	4.8 (4.0, 5.6)	27.4 (25.4, 29.3)	9.3 (8.0, 10.6)
P-value	0.00	0.22	0.00	0.73	0.00	0.36
Household income						
Less than $30 000	60.7 (57.7, 63.7)	17.2 (14.6, 19.7)	18.0 (16.0, 20.1)	4.1 (3.1, 5.1)	31.1 (28.4, 33.8)	7.6 (6.1, 9.2)
$30 000–49 999	60.0 (56.7, 63.3)	15.4 (12.9, 17.9)	19.6 (17.1, 22.2)	4.9 (3.6, 6.2)	21.4 (18.9, 23.8)	9.1 (7.4, 10.7)
$50 000–99 999	59.6 (56.3, 62.8)	12.9 (10.6, 15.1)	21.4 (19.0, 23.8)	6.2 (4.3, 8.0)	19.4 (17.0, 21.8)	10.8 (8.5, 13.0)
$100 000+	67.0 (61.6, 72.4)	11.0 (7.2, 14.9)	17.6 (14.0, 21.3)	4.3 (2.5, 6.2)	11.8 (8.9, 14.8)	9.0 (6.4, 11.6)
Unknown	67.5 (62.1, 72.8)	13.6 (9.7, 17.5)	16.3 (12.6, 20.0)	2.6 (1.2, 3.9)	21.4 (16.9, 25.9)	7.5 (4.7, 10.4)
P-value	0.04	0.04	0.12	0.03	0.00	0.20
Education level						
Less than high school	62.6 (58.2, 66.9)	16.6 (12.9, 20.2)	16.3 (13.6, 19.0)	4.5 (2.7, 6.3)	25.6 (22.0, 29.2)	7.6 (5.2, 10.0)

	Pack[b]		Carton[b]			
	No coupon	Coupon	No coupon	Coupon	Generic brands[c]	Indian reservation[d]
High school or equivalent	62.0 (59.3, 64.6)	14.5 (12.5, 16.5)	19.2 (17.2, 21.2)	4.4 (3.4, 5.4)	23.1 (20.9, 25.3)	8.4 (7.0, 9.7)
Some college	59.2 (56.6, 61.9)	15.3 (13.5, 17.2)	19.9 (17.8, 22.0)	5.5 (4.4, 6.6)	22.1 (20.1, 24.2)	10.4 (8.8, 12.1)
Bachelor or higher	62.1 (58.5, 65.7)	11.5 (8.9, 14.2)	22.7 (19.8, 25.7)	3.6 (2.5, 4.8)	24.7 (21.4, 27.9)	8.8 (6.8, 10.9)
P-value	0.39	0.08	0.02	0.15	0.31	0.17
Marital status						
Married or cohabitate	59.2 (56.9, 61.6)	14.0 (12.3, 15.7)	21.4 (19.6, 23.2)	5.3 (4.5, 6.2)	24.1 (22.1, 26.0)	9.6 (8.3, 11.0)
Widowed, divorced or separated	53.9 (50.6, 57.3)	15.2 (12.5, 17.9)	25.7 (22.9, 28.4)	5.2 (3.8, 6.6)	32.2 (29.2, 35.3)	9.3 (7.6, 11.0)
Not in a stable relationship	71.6 (68.3, 74.8)	16.3 (13.5, 19.1)	9.0 (7.4, 10.7)	3.1 (1.7, 4.5)	15.0 (12.8, 17.2)	6.9 (5.2, 8.7)
P-value	0.00	0.36	0.00	0.02	0.00	0.05
Unemployed						
Yes	58.4 (55.8, 61.0)	14.2 (12.2, 16.2)	21.5 (19.6, 23.4)	5.9 (4.7, 7.1)	28.3 (26.1, 30.5)	7.7 (6.5, 9.0)
No	63.7 (61.5, 65.9)	15.5 (13.9, 17.2)	17.1 (15.5, 18.6)	3.7 (3.0, 4.4)	19.7 (18.0, 21.4)	9.7 (8.4, 11.0)
P-value	0.00	0.32	0.00	0.00	0.00	0.03
Smoking status						
Daily	56.0 (54.0, 57.9)	15.2 (13.7, 16.6)	23.2 (21.8, 24.7)	5.7 (4.8, 6.5)	25.2 (23.7, 26.8)	9.3 (8.4, 10.3)
Non-daily	79.4 (76.3, 82.5)	14.3 (11.5, 17.0)	5.0 (3.4, 6.5)	1.3 (0.8, 1.9)	18.0 (15.3, 20.7)	7.0 (4.7, 9.3)
P-value	0.00	0.57	0.00	0.00	0.00	0.07
Cigarettes per day						
<10	78.2 (75.5, 80.9)	13.7 (11.4, 16.1)	6.5 (5.2, 7.9)	1.6 (1.0, 2.1)	16.2 (14.2, 18.3)	7.3 (5.4, 9.1)
10–19	59.1 (56.2, 62.1)	17.6 (15.2, 20.0)	18.2 (16.1, 20.3)	5.1 (3.9, 6.3)	22.5 (20.2, 24.9)	8.2 (6.9, 9.6)
20+	48.7 (46.0, 51.4)	13.7 (11.5, 15.8)	30.5 (28.2, 32.9)	7.1 (5.7, 8.5)	30.5 (28.1, 32.9)	10.9 (9.3, 12.4)
P-value	0.00	0.03	0.00	0.00	0.00	0.01
Quit attempt						
Yes	65.9 (63.4, 68.3)	17.4 (15.3, 19.4)	12.8 (11.3, 14.3)	4.0 (2.9, 5.0)	21.4 (19.5, 23.4)	8.4 (7.1, 9.7)
No	56.9 (54.6, 59.3)	13.0 (11.3, 14.7)	24.7 (22.8, 26.6)	5.4 (4.5, 6.3)	25.1 (23.2, 27.1)	9.3 (8.0, 10.7)
P-value	0.00	0.00	0.00	0.05	0.01	0.32
Smoke after waking						
Within 5 minutes	54.2 (50.5, 57.8)	16.1 (13.2, 19.0)	22.7 (20.1, 25.3)	7.0 (5.1, 9.0)	28.5 (25.4, 31.6)	9.7 (7.7, 11.7)
6–30 minutes	52.8 (49.8, 55.9)	14.7 (12.5, 16.8)	27.0 (24.4, 29.7)	5.5 (4.3, 6.7)	27.0 (24.4, 29.7)	10.1 (8.4, 11.8)
More than 30 minutes to 1 hour	59.3 (55.2, 63.4)	15.2 (12.0, 18.5)	20.6 (17.6, 23.6)	4.9 (3.3, 6.4)	21.2 (18.2, 24.2)	8.7 (6.6, 10.7)

	Pack[b]		Carton[b]			
	No coupon	Coupon	No coupon	Coupon	Generic brands[c]	Indian reservation[d]
After an hour	75.5 (72.7, 78.2)	14.1 (11.7, 16.5)	8.3 (6.9, 9.8)	2.1 (1.5, 2.7)	18.3 (16.1, 20.5)	7.0 (5.3, 8.7)
P-value	0.00	0.75	0.00	0.00	0.00	0.06
Overall	61.3 (59.7, 63.0)	14.9 (13.6, 16.2)	19.0 (17.8, 20.2)	4.7 (4.0, 5.3)	23.6 (22.2, 24.9)	8.8 (7.9, 9.7)
n	6466	1394	3492	700	3773	1260

[a] Sample size less than 30 or relative standard error greater than 30%.

[b] Survey questions related to coupon use and carton purchase were asked for the latest purchase.

[c] The cigarette brand information was collected for the past 30 days.

[d] The Indian reservation purchase information was asked for the previous year.

Table 2

Adjusted and unadjusted average cigarette price by price-minimizing strategy.

Price-minimizing strategies	Unadjusted		Adjusted	
	n	Average price[a]	n	Average price[a]
Pack purchasers only[b]				
Total	9 933	5.48* (2.62)	8 106	5.62* (2.91)
Coupon	1 755	5.14* (2.10)	1 431	5.15* (2.05)
No coupon	8 178	5.57* (2.73)	6 675	5.75* (3.08)
Carton purchasers only[b]				
Total	5 338	4.06* (2.70)	4 356	4.38* (3.55)
Coupon	877	4.09* (2.49)	729	4.37* (3.00)
No coupon	4 461	4.05* (2.79)	3 627	4.39* (3.72)
Outside Indian reservations[c]				
Total	11 160	5.15* (2.95)	11 160	5.62 (3.31)
Coupon	1 902	4.86 (2.28)	1 902	5.16* (2.33)
No coupon	9 258	5.21* (3.10)	9 258	5.73 (3.50)
Indian reservations[c]				
Total	1 302	4.74* (2.70)	1 302	5.67 (3.16)
Coupon	258	4.75 (2.84)	258	5.60* (3.41)
No Coupon	1 044	4.74* (2.61)	1 044	5.70 (3.00)
Premium brands[d]				
Total	10 206	5.42* (2.62)	8 340	5.63* (2.93)
Coupon	2 170	5.02 (2.12)	1 765	5.18 (2.24)
No coupon	8 036	5.53* (2.73)	6 575	5.75* (3.04)
Generic brands[d] (discounted and other)				
Total	4 808	4.31* (3.18)	3 909	4.74* (4.51)
Coupon	–	–	–	–
No coupon	4 382	4.34* (3.20)	3 542	4.76* (4.54)

[a] Standard deviations are shown in parentheses.

[b] Adjusted for purchase from brand (generic = 1 and others = 1) and Indian reservation (Indian = 1).

[c] Adjusted for pack purchase (carton = 1) and brand (generic = 1 and others = 1).

[d] Adjusted for carton purchase (carton = 1) and purchase from Indian reservation (Indian = 1).

* $P \leq 0.05$.

Table 3

Estimated tax pass-through rates by price-minimizing strategy.

Price-minimizing strategies	n	Adjusted for demographic and seasonal controls Pass-through rate[e]	Adjusted for demographic, seasonal, and state controls Pass-through rate[e]
Pack purchasers only[a]			
Total	7 860	1.18* (2.55)	1.10* (2.72)
Coupon	1 394	1.12* (2.05)	1.07* (2.18)
No coupon	6 466	1.19* (2.52)	1.10* (2.72)
Carton purchasers only[a]			
Total	4 192	0.66* (3.97)	0.66* (4.49)
Coupon	700	0.75* (2.77)	0.76* (3.23)
No coupon	3 492	0.65* (3.96)	0.65* (4.42)
Outside Indian reservations[b]			
Total	10 792	1.13* (2.87)	1.06* (3.14)
Coupon	1 845	1.11* (2.23)	1.07* (2.49)
No coupon	8 947	1.13* (2.94)	1.05* (3.19)
Indian reservations[b]			
Total	1 260	0.46* (2.72)	0.50* (2.96)
Coupon	249	0.38* (2.42)	0.30* (2.39)
No coupon	1 011	0.52* (2.61)	0.57* (2.86)
Premium brands[c]			
Total	8 088	1.10* (2.71)	1.04* (2.82)
Coupon	1 716	0.99* (2.62)	0.95* (2.81)
No coupon	6 372	1.13* (2.68)	1.06* (2.77)
Generic brands[d] (discounted and other)			
Total	3 766	0.88* (3.62)	0.82* (4.11)
Coupon	–	–	–
No coupon	3 415	0.90* (3.59)	0.83* (4.18)

All regression models include respondents' age, race/ethnicity, gender, household income, education, marital status, employment status, as well as indicators for seasonal effects. State controls include state tobacco funding per capita, smoke-free air laws and anti-smoking sentiment. In addition,

[a] adjusted for brand choice and Indian reservation purchase;

[b] adjusted for carton purchase, brand choice and coupon use;

[c] adjusted for carton purchase, Indian reservation purchase and coupon use;

[d] adjusted for carton purchase and Indian reservation purchase.

[e] For each row, an independent model was run restricted to those with the price-minimizing strategies for that row.

We compared estimates between carton versus pack, Indian reservation versus no Indian reservation and premium brands versus generic brands, and found that the estimates were significantly different for all ($P \leq 0.05$). Standard deviations are shown in parentheses.

*$P < 0.05$.